

**CLAIMS**

1. A method for the removal of substances from a solid matrix with an operating fluid in which the substances are soluble, comprising the steps of:

- washing the solid matrix with the operating fluid in liquid or supercritical phase, so as to obtain a solution formed by the fluid with the substances dissolved therein,
- expanding the solution and heating it so as to evaporate the operating fluid and separate it from the substances dissolved therein,
- compressing the evaporated fluid and cooling it to bring it back to the initial liquid or supercritical phase,

characterized in that at least some of the heat supplied to heat the solution and some of the heat removed by cooling the fluid after compression are obtained by providing for a heat exchange between the respective stages of the cycle.

2. A method according to Claim 1, wherein for bringing about the heat exchange, the heating temperature of the solution is between 0°C and 20°C, and the cooling temperature of the fluid is between 15°C and 35°C.

3. A method according to Claim 1 or 2 wherein for bringing about the heat exchange, the heating pressure of the solution is between 40 and 55 bar and the cooling pressure of the fluid is between 50 and 70 bar.

4. A method according to any one of Claims 1 to 3, wherein the operating fluid is one of the following: carbon dioxide, alkane or alkene with a number of carbon atoms less than or equal to 4, hydrofluorocarbon (HFC).

5. A method according to any one of the preceding claims, wherein the step of the separation of the

substances dissolved in the fluid is carried out with a cyclone separator (32), after the exchange of heat for heating the solution.

6. A method according to any one of the preceding claims, wherein the solid matrix is constituted by swarf from machining operations and the substances to be removed comprise lubricating oils or similar organic substances.

7. Apparatus for carrying out the method according to any one of the preceding claims, comprising a path for the movement of the operating fluid along which there are: a container (23, 24) for containing the solid matrix to be treated, a valve (28) for the expansion of the fluid, a separator (32), and a compressor (36), characterized in that it comprises a heat exchanger (30) which provides for an exchange of heat between a portion of the path of the fluid disposed between the expansion valve and the separator and a portion downstream of the compressor.

8. Apparatus according to Claim 7, wherein the heat exchanger (30) is a plate-type exchanger.

9. Apparatus according to Claim 8, wherein the heat exchanger (30) comprises an outer casing (50) which communicates with the path of the fluid and which houses a set of plates (52) through which the solution to be heated and the fluid to be cooled circulate.

10. Apparatus according to any one of Claims 7 to 9, wherein the separator (32) is a cyclone separator.

11. Apparatus according to any one of Claims 7 to 10, comprising at least two containers (23, 24) for containing the solid matrix to be treated, the containers being arranged in parallel along the path of the fluid so as to be used alternately in successive operating cycles.

12. A heat exchanger for the apparatus according to any one of Claims 7 to 12, comprising an outer casing (50) which houses a set of plates (52), and connecting means (53-57) for the circulation of fluids through the casing and through the set of plates.